MULTI-POLARIZATION C-BAND SAR SIGNATURES OF ARCTIC SEA ICE

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ABSTRACT

The Advanced Synthetic Aperture Radar (ASAR) is scheduled to be launched on the ENVISAT satellite in summer 2001. ASAR will be operated at C band with multiple polarizations and multiple incidence angles. For Arctic sea ice mapping using future ASAR data, we carry out a study of multiple polarization C-band SAR signatures of various sea ice types. We present polarimetric SAR data acquired over sea ice acquired by the Jet Propulsion Laboratory (JPL) polarimetric AIRSAR system on the NASA DC-8 aircraft over sea ice regions in the Beaufort Sea and the Bering Sea. We use a physical sea ice model to obtain and study polarimetric scattering signatures of sea ice with typical Arctic ice properties. The sea ice model is used to calculate multiple polarization signatures of sea ice under various conditions to determine how to exploit the multiple polarization features at different incidence angles. We also compare sea ice signatures with backscatter of ocean surface at different wind speeds using an empirical C-band ocean wind geophysical model function. The results show that, for σ_{vv} alone (like ERS-1,2), ocean backscatter response is similar to multi-year (MY) ice at small incidence angle θ, and similar to first-year (FY) ice at large θ. For σ_{hh} alone (like RADARSAT-1), ocean signature at C band is similar to MY ice at small θ, and similar to FY ice from middle to large θ. For σ_{hv} alone, ocean is similar to FY ice, but well distinguished from MY ice for all θ; however, σ_{hv} for ocean and FY is very low for a typical satellite SAR noise floor. With copolarized ratio $\gamma=\sigma_{vv}/\sigma_{hh}$, ocean and ice (both FY and MY ice) are well classified for incidence angle larger than 35°. The use of copolarized backscatter and polarization ratios yields a good discrimination of different ice types and open ocean. Under cold conditions, backscatter threshold level of -15dB (σ_{vv}, σ_{hh}) is an identifying threshold for FY and MY. With this study, we select appropriate SAR modes with different polarizations and incidence angle to derive more accurate or more robust results for sea ice mapping compared to current satellite single-polarization C-band SARs.